The Conference Board
Economic Research Program

70th Anniversary

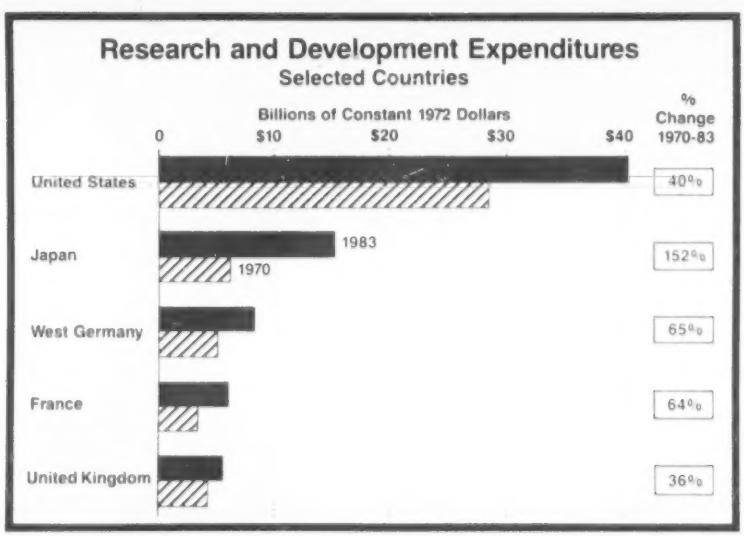
NOW AVAILABLE in SLIDES
Details on back page

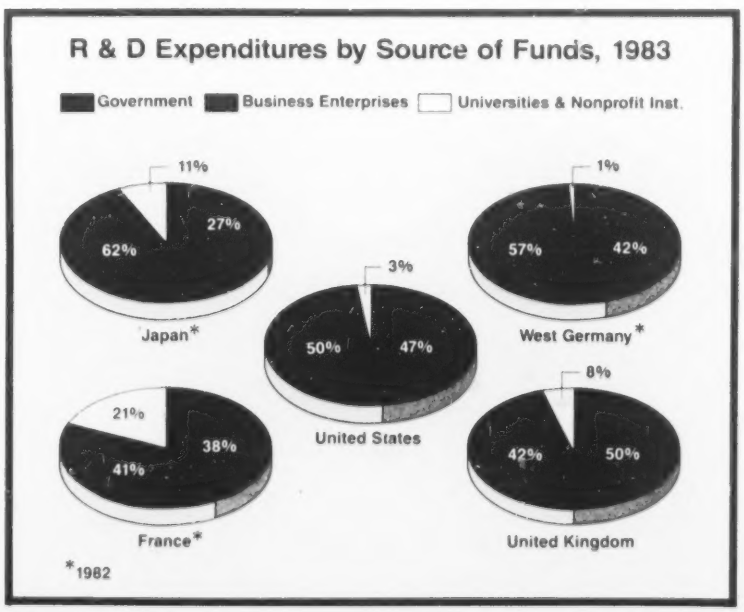
Research and Development

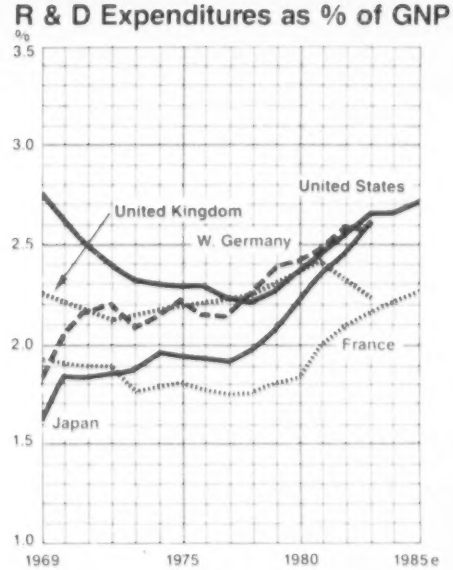
Economic Road Maps
Nos. 2007-2008

October, 1986

Investment in Research and Development (R&D) is an essential ingredient of technological innovation, a factor contributing to economic growth and competitiveness, and, as a result, an improved national standard of living. In absolute terms, the United States spends more on R&D than any other Western industrial country. However, in recent years some countries' outlays have grown at a much faster rate.

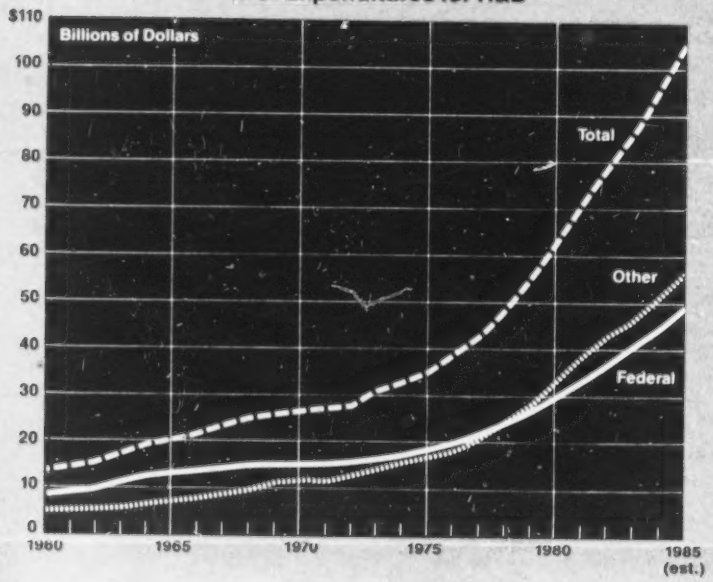


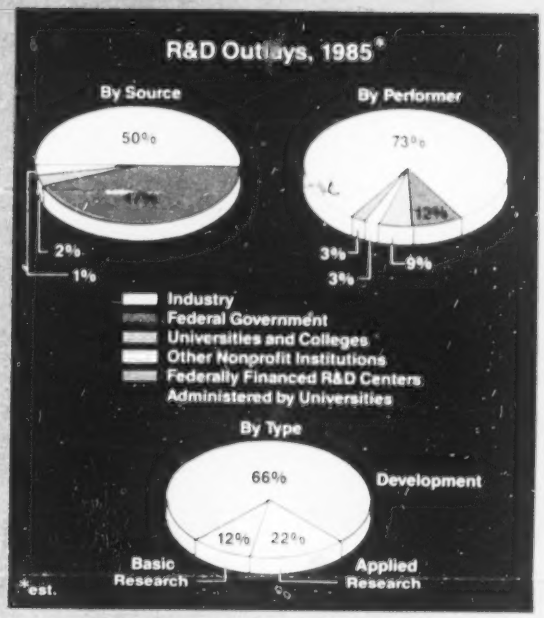




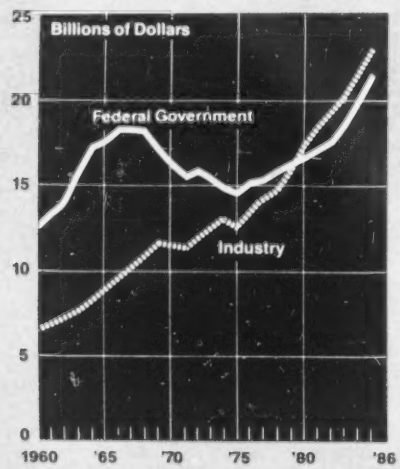
- U.S. expenditures on R&D were somewhat larger than the combined expenditures of Japan, West Germany, France and the U.K. in 1983, the latest year for which comparable date are available. But since the early 1970s all these countries, with the exception of the U.K., had higher growth rates than the United States.
- In the immediate post World War II era, the United States had the highest R&D/GNP ratio; but that dominant position was eroded in subsequent years until by 1978, both West Germany and the U.K. were ahead of the United States. However, from 1983 on this country began to reestablish its preeminence.
- The U.S., France, and the U.K. devote relatively higher shares of their R&D resources to defense-related activities than do West Germany and Japan. Those two countries, on the other hand, support a larger civilian research effort.

U.S. Expenditures for R&D

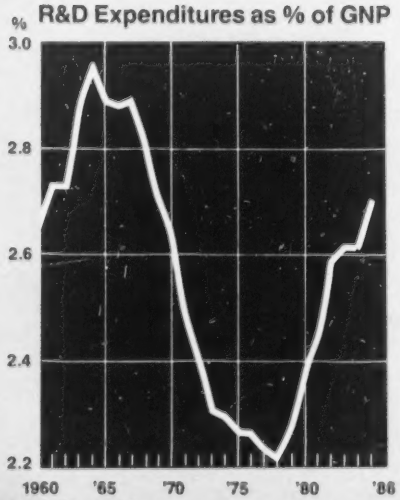




R&D Expenditures in 1972 Dollars



R&D Expenditures as % of GNP

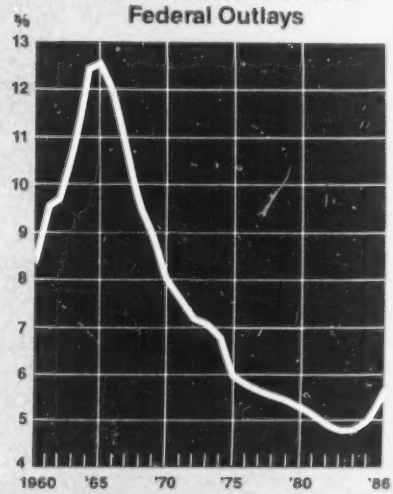


1983 preliminary
1984 and 1985 est.

- In the United States, R&D expenditures have shown strong growth since the mid-1970s with $107 billion spent in 1985. Spending by industry accounted for 50% and by the Federal government for 47% of the total, with the remaining 3% spent by the academic sector and nonprofit organizations.
- In recent years, Federal government funds went to support both defense as well as nondefense basic research, but the growth in the government's involvement remained moderate as the Administration considered the private sector a more suitable initiator of technological effort. Industry R&D funding has lately centered on increased spending by high-technology firms.
- Industry performs almost three-quarters of current R&D in the U.S., accounting for 73% of all expenditures in 1985. Even higher ratios were attained in the early 1960s; they declined in later years, and only lately approached again the high levels of 25 years ago. The Federal government's performance fluctuates according to shifts in its R&D priorities, with 12% of R&D performed by this sector in 1985.

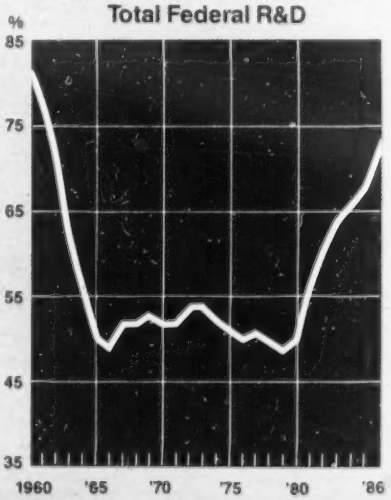
Support for basic research has increased during the past quarter century—from under 9% in 1960 to approximately 12% of the total in 1985; this ratio has held fairly steady since 1976. Primary support for basic research comes from the Federal government, which funded two-thirds of all investment in basic research in 1985. As a result of faster growth in industrial support, however, the Federal share of to-

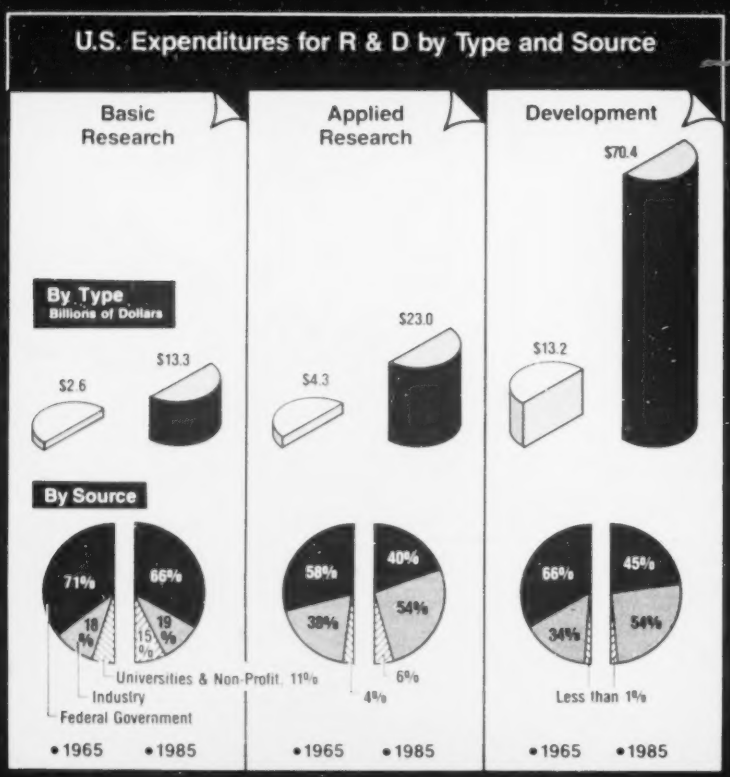
Federal R&D as % of Total Federal Outlays



1984 and 1985 est.

Defense Related R&D as % of Total Federal R&D





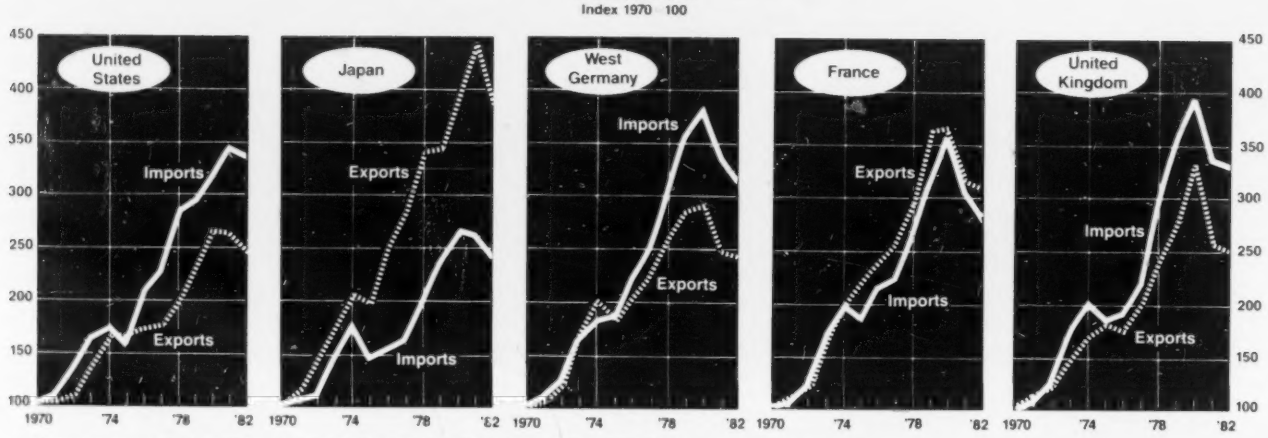
tal R&D has declined. Between 1980 and 1985, industrial support grew at an average annual rate of 8.5%, against growth of 3.7% for Federal support. In spite of the increased involvement of industry in basic research, such activity accounts for only a small portion of industry's R&D support.

• Funding for applied research is usually around 20% of the total, but there has been a change in the composition —since 1980 Federal support, which predominated in the past, has been replaced by industry.

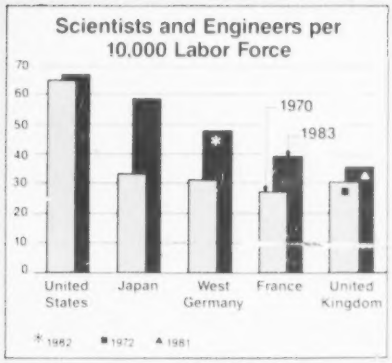
• The major portion of total R&D expenditures goes into development—66% in 1985. While Federal support is smaller than that of the private sector, it has grown considerably faster in recent years. Between 1980 and 1985, government funding of development increased at an average annual rate of 7.1% against a growth of 4.1% for industry, mainly as a result of defense R&D expenditures.

• The strength of a country's R&D effort can be measured in relation to its overall economic growth. In this country, the ratio has recovered substantially, from a low of 2.2% in 1978 to 2.7% in 1985. This rise reflects a vigorous growth of R&D expenditures in the face of slower growth in economic activity. Measured in constant dollars, R&D expenditures grew at an average annual rate of 5% between 1976 and 1985, compared with GNP growth of only 2.7 percent.

• Over the years, the United States recorded a substantial trade surplus in high-technology products, even as the balance on other manufactures sank into an ever-deeper deficit. But since 1980, even the high-tech trade balance has declined. Between 1980 and 1983 the high-tech trade surplus, measured in constant dollars, fell by over 40% (and is expected to decline further in 1984). However, imports of high-tech products by our major trading partners also fell by about 65% in the corresponding period. As a result, U.S. exports actually captured a slightly higher share of the international market in spite of the extraordinary strength of the dollar.



Technology-intensive products are defined as those for which R & D expenditures exceed 2.36% of value-added.



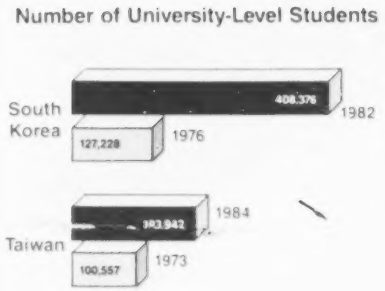
• In the long run, the training and availability of a competent scientific and engineering work force is an essential factor for technological innovation. While the United States has by far the largest such labor force, there is a strong and growing presence of foreign nationals in U.S. universities, especially at the graduate level. Today half of the doctoral degrees in engineering go to foreign students, up from about 23% twenty years ago. The ratio is high in other scientific fields as well.

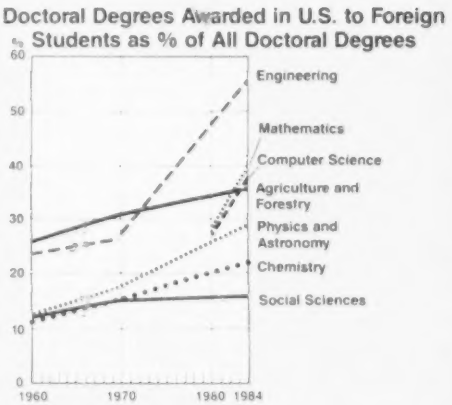
• There has also been a great surge in university-level training in the newly industrialized countries (NICs) in East Asia. Thus, South Korea, which in the mid-1970s had only one-fifth the number of students in engineering and science as did Japan, increased its share by 1982 to more than two-thirds of the Japanese total. Keeping in mind that these countries' presence in international trade in high-tech products is growing fast, the implications for U.S. trade in these products are evident.

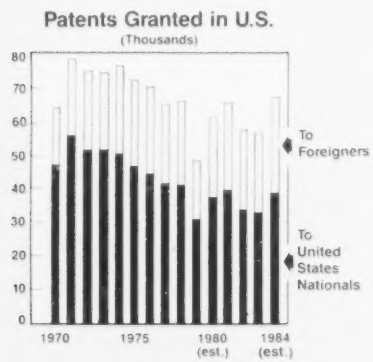
• In each year of the 1980s fewer patents have been granted in the United States than in the 1970s. Moreover, there has also been a decline in the proportion of patents issued to U.S. citizens, along with a rise in the average number awarded in the U.S. to foreigners, especially the Japanese.

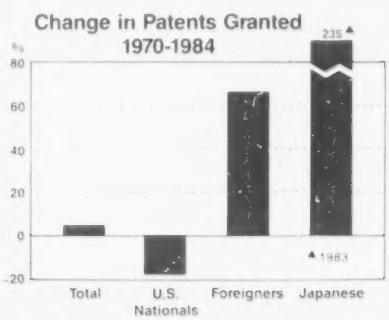
Eva Culen

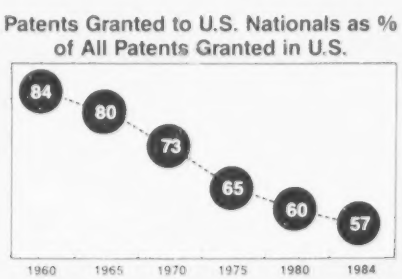
Sources: National Science Board; Joint Economic Committee; The Conference Board.











NOW AVAILABLE . . .

Economic Road Maps charts as SLIDES

Each set of slides comes in a binder also containing 25 copies of the Road Map

The Conference Board
70th Anniversary
845 Third Avenue
New York, NY 10022

Please send me a set of slides for
Economic Road Map Nos. 200, 208
"Research and Development"

Introductory Offer:
$180 ~~$225~~ ($75 if educational Institutions only)

Enclosed is my check for $ Please bill me

Name Title
Company Tel
Address

Slides are also available for each individual Road Map.
For further information please contact Eva Culen (212) 759-0900 ext. 358

ECONOMIC ROAD MAPS

Eva Culen, Editor Chuck N. Tow, Chief Chartist
Prices for Quantities of this chart will be supplied on request to Information Service.

Published by
THE CONFERENCE BOARD, INC.
845 Third Avenue, New York, N.Y. 10022 Avenue Louise, 207 Bte 5 B-1050 Brussels, Belgium
THE CONFERENCE BOARD OF CANADA
255 Smyth Road, Ottawa, Ontario K1H-8M7, Canada

The Conference Board
Economic Research Program

HOW AVAILABLE IN SLIDES

Productivity: 1960-1986 An International Comparison

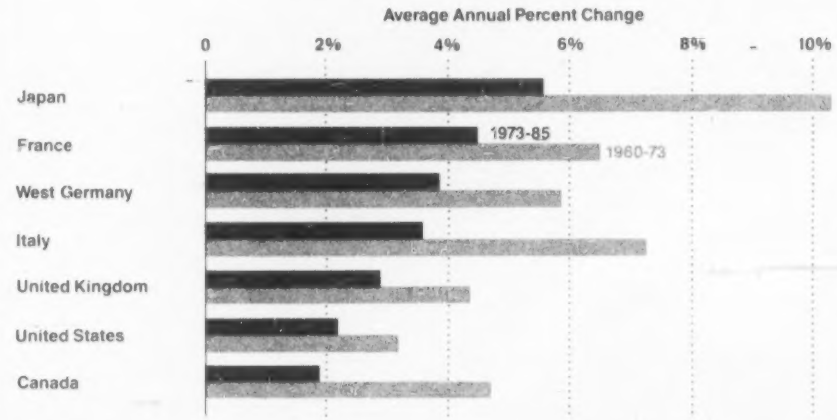
Economic Road Maps
Nos. 2009-2010
April, 1987

Advances in productivity are crucial to economic growth and increases in standards of living. Increasing productivity makes more goods and services available, raising the standard of living.

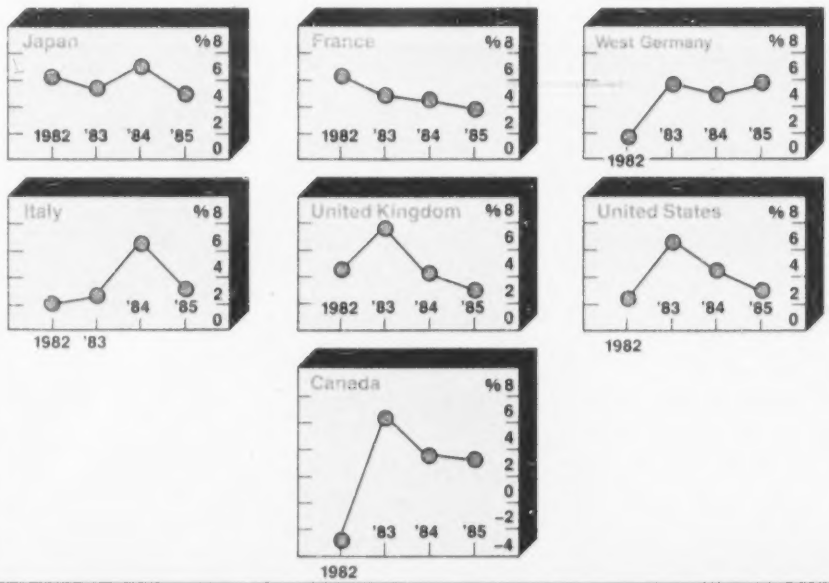
Throughout history, productivity has continually increased in nearly every country. Productivity advanced with unusual speed in the first two decades after World War II. More recently, however, the increase in productivity has been slowing in most countries. In addition, differences in the levels of productivity narrowed among industrial countries.

25 Years of Productivity Growth

(Output per hour in manufacturing)

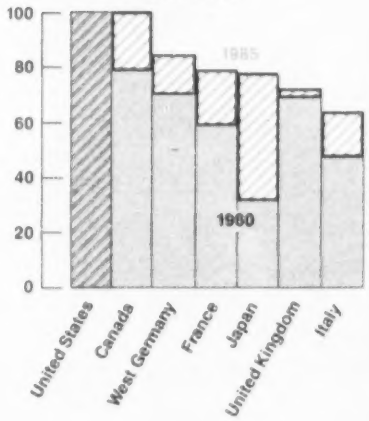


. . . and Recent Trends



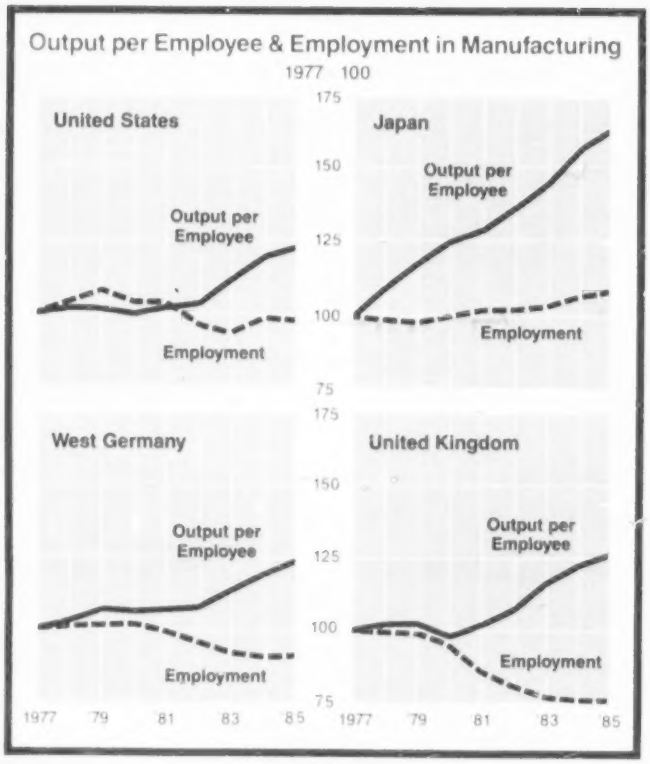
Real Gross Domestic Product Per Capita

U.S. = 100



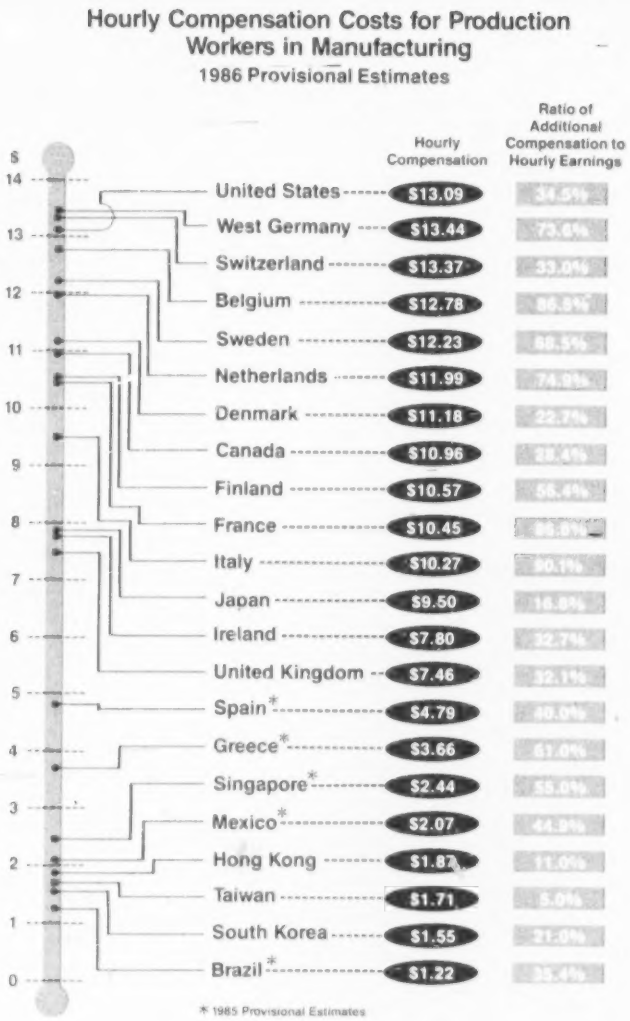
But back in 1960 the major industrial economies showed very divergent productivity levels. Measured productivity in the manufacturing sector in Japan was only one-third the U.S. level. Italy's productivity was about one-half, and France's just under two-thirds, the U.S. level. West Germany and the U.K. had productivity levels just over two-thirds that of the U.S. and Canada's productivity was about three-quarters of the U.S. rate.

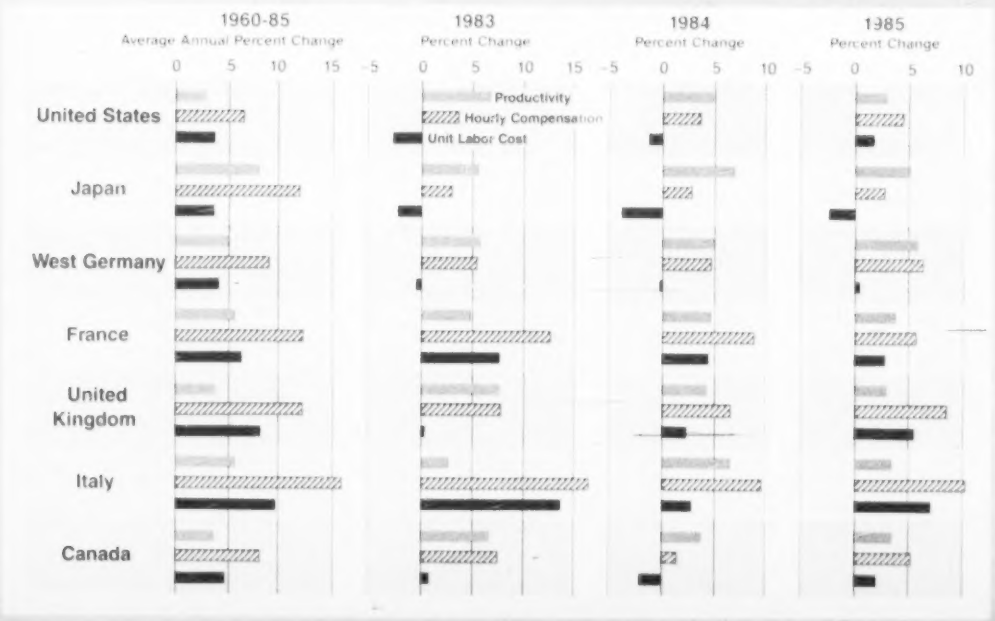
Between 1960 and 1973, U.S. productivity rose by an average of 3.2% per year, an above-average performance. Yet during the 1960's, the other six industrial countries all achieved higher—in some cases, substantially higher—productivity gains: Japan had a 10.3% annual gain, Italy 7.3%, France 6.5%, and West

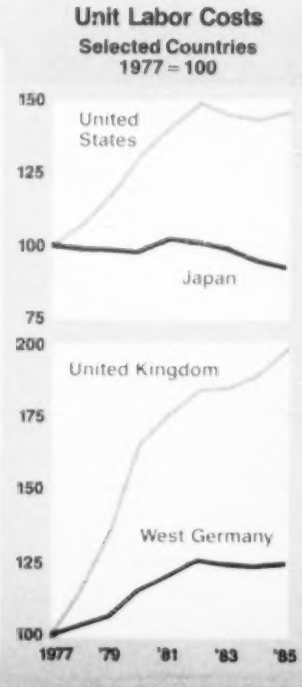


Germany 5.8 percent. Even the U.K. and Canada achieved slighly higher productivity gains than the U.S.

During 1973-1985, gains in productivity were uniformly lower than those experienced during 1960-1973. Recessions in the mid-1970's and again in the early 1980's, as well as the two oil-price shocks, affected productivity growth. Also, at least for some of the latter period, economic policies were more concerned with fighting inflation than with stimulating economic growth. Slower growth contributed to slower productivity gains.







Most industrialized countries were affected. Japan's rate, for example, was 5.6% per year between 1973-1985, down from 10.3% between 1960-1973. In Italy, productivity growth slowed from 7.3% to 3.6 percent. And in Canada, it fell from 4.7% to only 1.9 percent.

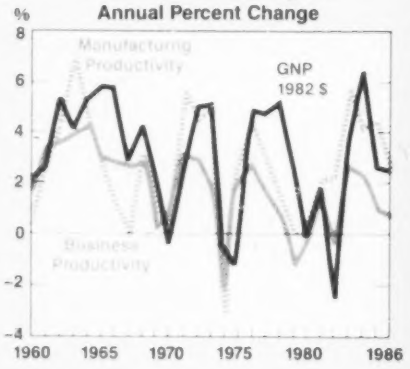
The slide was less pronounced in the other four countries: in France from 6.5% to 4.5%; in West Germany from 5.8% to 3.8%; and in the U.K. from 4.3% to 2.8 percent. The decline was least pronounced in the U.S.: from 3.2% to 2.2 percent.

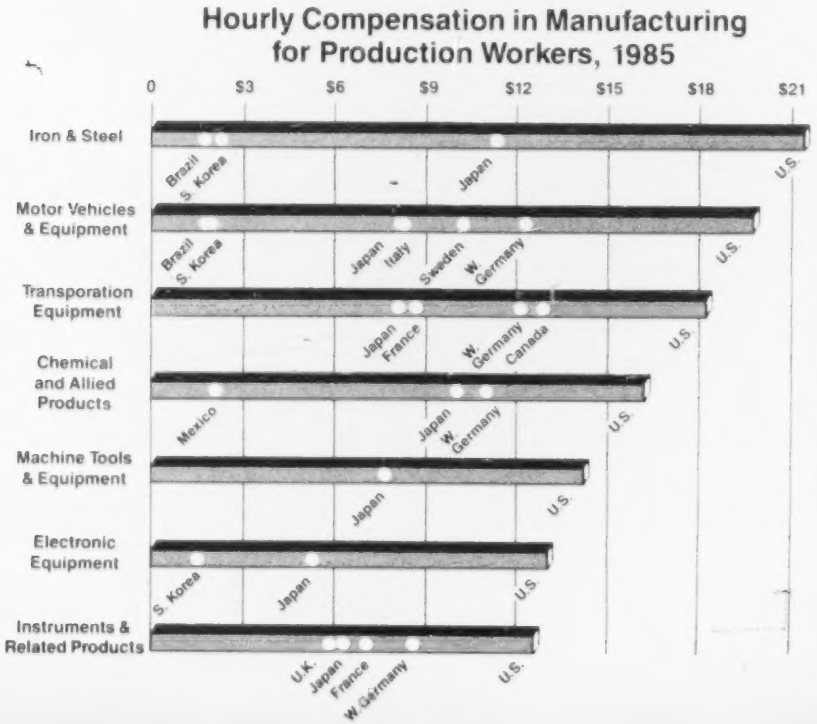
For the developed countries, productivity gains in the manufacturing sector continued to run above the U.S. rate through the mid-1980's. As a result, the differing manufacturing levels of productivity converged. By 1985, Canada's productivity level equaled that of the U.S.; Japan, France, and West Germany were not far behind.

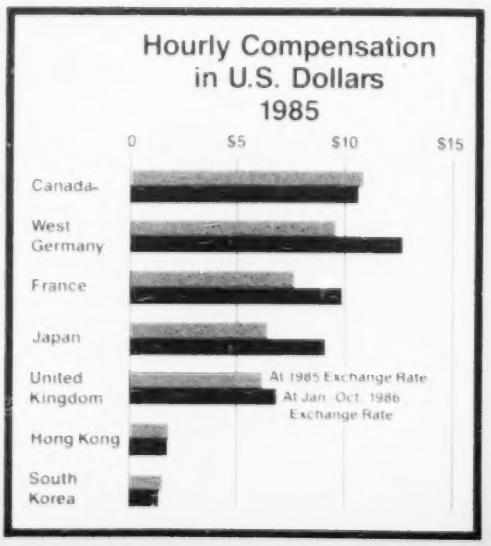
Italy's level of productivity equaled that of the U.K. by 1985, and reached two-thirds the U.S. level of output per worker-hour. Productivity in the U.K., conversely, was no closer to the U.S. level in 1985 than it was in 1960.

To a large degree, wages reflect productivity levels. But although productivity levels in the U.S. and Canada were about equal in 1986, the average hourly wage in U.S. manufacturing was $13.09, while Canada's was $10.96 (both measured in U.S. dollars.) And since U.S. workers generally pay less tax, the difference in take-home pay was a little more pronounced. However, the falling dollar closed the gap in some instances.

Will productivity growth rates start to rise faster? Many signs seem favorable.



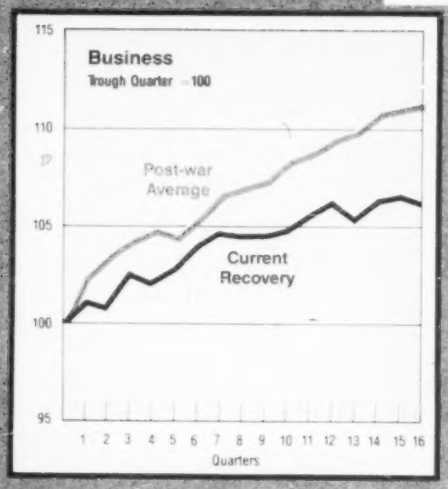


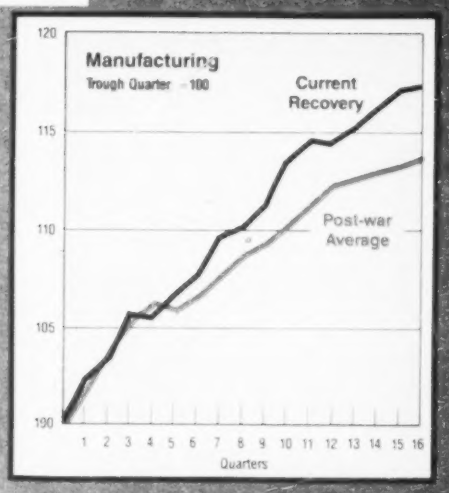


U.S. Productivity, Unit Labor Costs & the Business Cycle

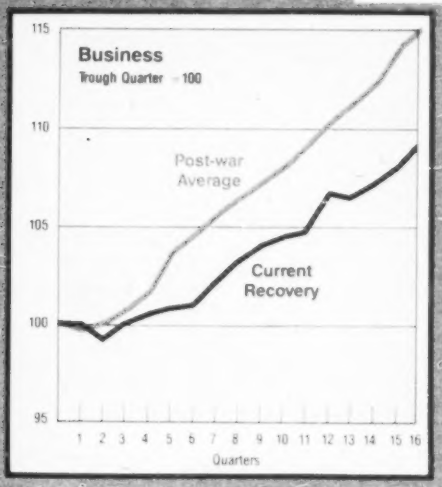
(16 Quarters after the Trough)

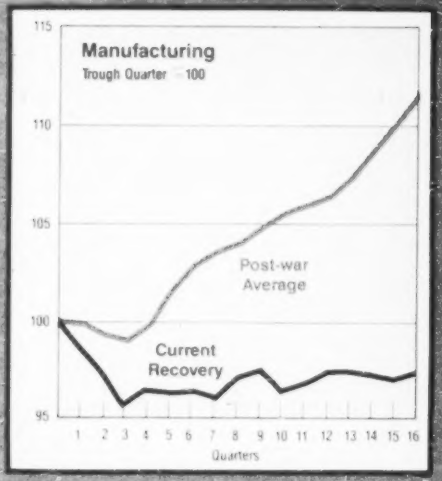
Productivity





Unit Labor Costs





The most recent oil-price shock resulted in a sharp reduction in price, not an increase. Economic policy has been shifting toward accommodating economic growth rather than fighting inflation, which remains reasonably in check.

However, even with all of these positive forces, productivity growth rates may not start to rise faster. One factor is the growing role of services in developed countries. It has always been easier to generate productivity gains, by substituting capital for labor, in goods production than in services.

Looking ahead, unless measured productivity in services increases faster, total productivity growth may not accelerate in the major developed countries. Conversely, as the goods-production capability in the developing countries expands over the next few years, high productivity growth is likely to occur there, reducing the gap with the developed countries. And as global differences in wages converge, quality and cost differences of products will narrow. That will intensify global competition over the next decade.

Eva Culen
Ken Goldstein

Sources: U.S. Departments of Labor and Commerce; The Conference Board.

NOW AVAILABLE . . .

ECONOMIC ROAD MAPS

Eva Culen, Editor Chuck N. Tow, Chief Chartist
Prices for Quantities of this chart will be supplied on request to Information Service.

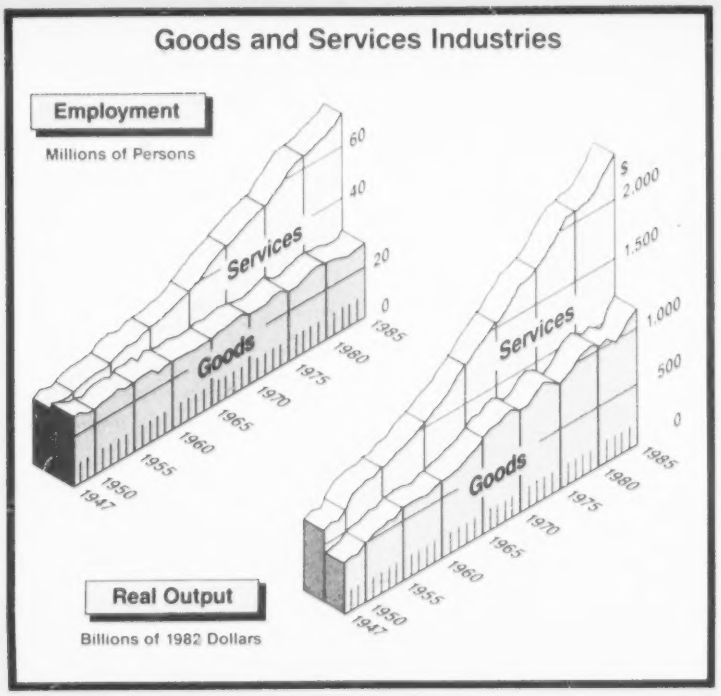
Published by
THE CONFERENCE BOARD, INC.
845 Third Avenue, New York, NY 10022 Avenue Louise, 207 Bte 5 B-1050 Brussels, Belgium
THE CONFERENCE BOARD OF CANADA
255 Smyth Road, Ottawa, Ontario K1H 8M7, Canada

The Conference Board
Economic Research Program

Output & Employment: A 40-Year Perspective

Economic Road Maps
Nos. 2011-2012
August, 1987

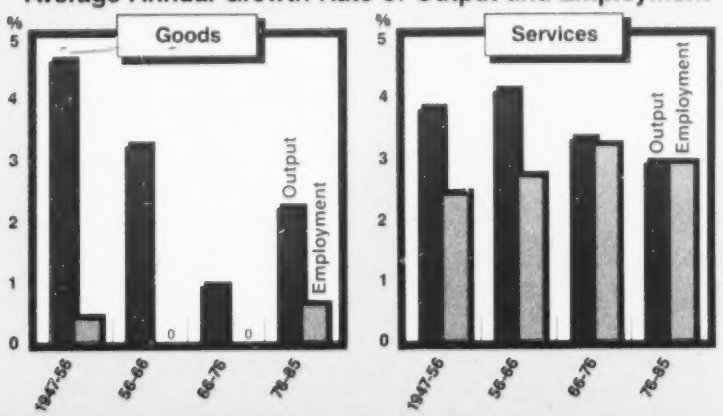
The United States is evolving from a goods-producing, manufacturing-based economy to one anchored in services and information. This specific transition to a "post-industrial" society is not a unique phenomenon. But the United States is the first (and largest) of the industrial countries to undergo the process. In an earlier era, workers "freed up" from the agricultural sector were utilized in manufacturing, and total output rose. In the current transition, labor is being made available to produce services, total output is rising, and the composition of output is evolving to meet a wider range of demands.



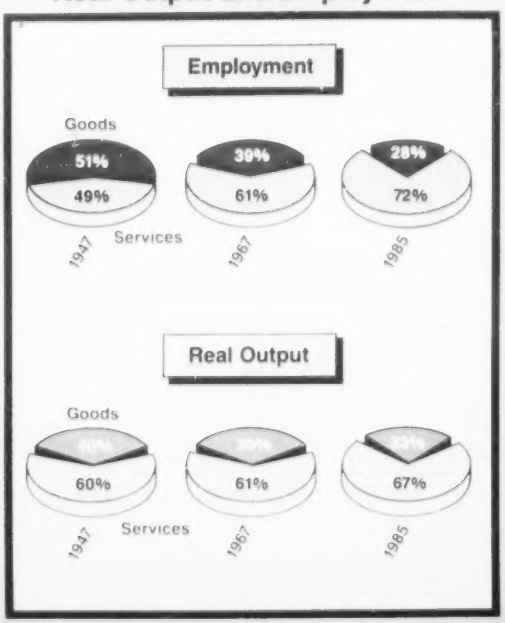
The U.S. labor market has been completely reshaped in the postwar period. In 1947, there were 52 million people employed, with more than half (28 million) engaged in goods production (manufacturing, mining and construction.) By 1985, total employment was nearly double but almost all of the net rise of 50 million jobs occurred in services. There was almost no net rise in goods-producing jobs.

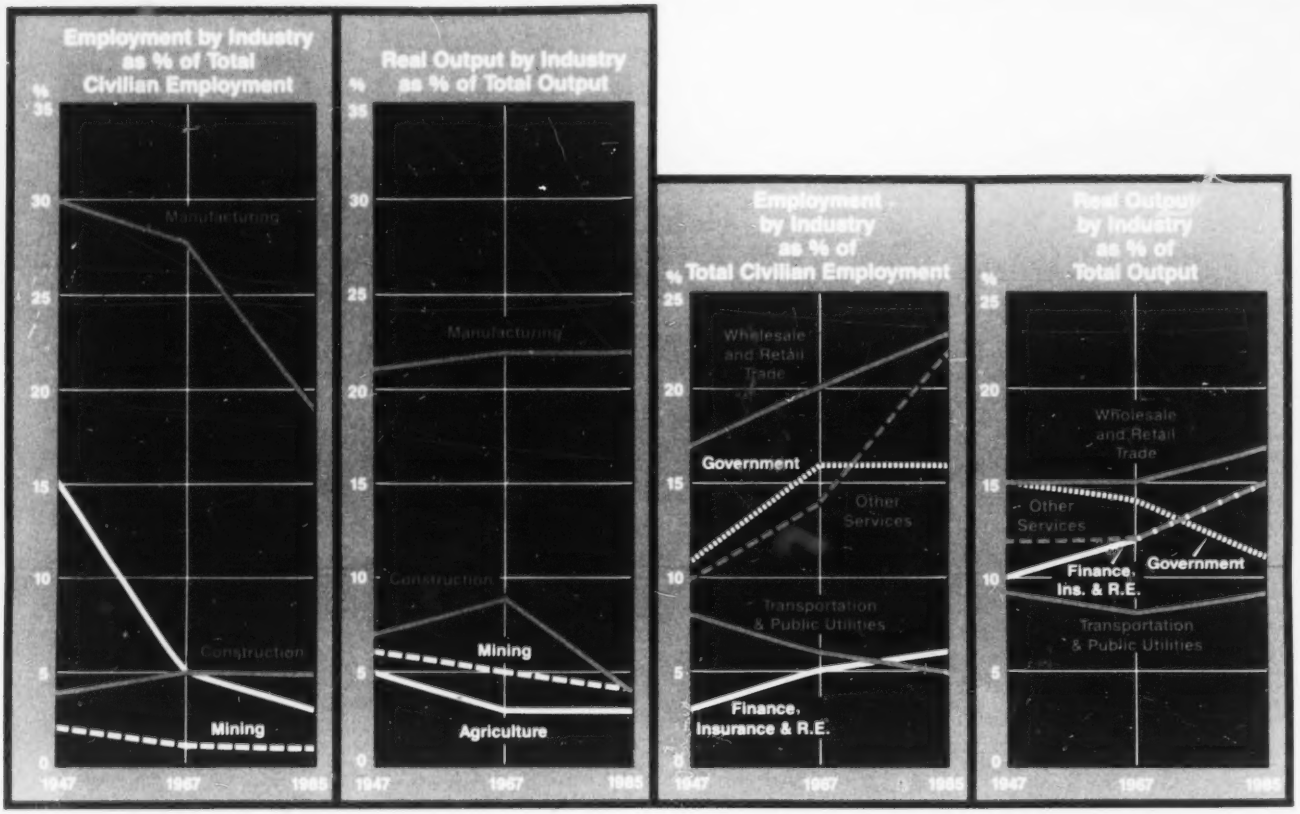
The composition of output changed more slowly than did the composition of employment. That reflects the fact that goods production rose as total production expanded, while goods employment remained stable. Over the period from 1947 to 1967,

Average Annual Growth Rate of Output and Employment



Distribution of Real Output and Employment

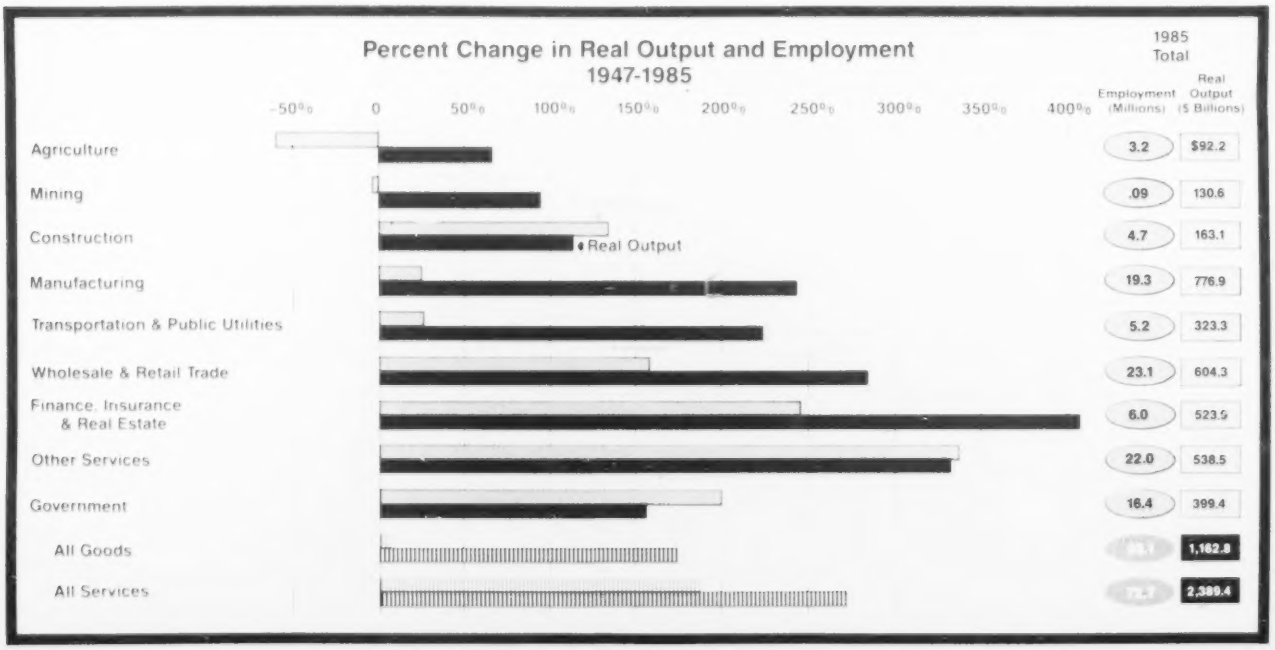


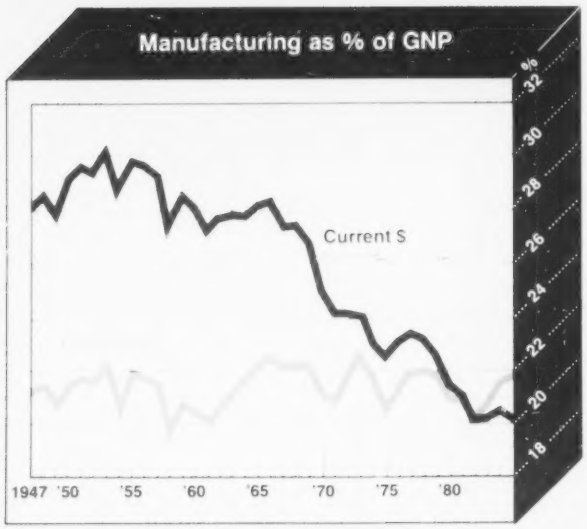


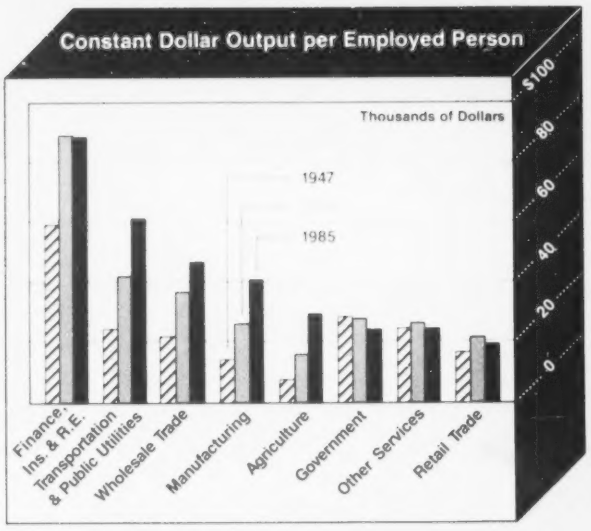
the rise in goods production matched the increase in economy-wide production. This pattern changed over the last 20 years, however, as growth in total output outpaced the rise in the production of goods. Over time, then, the output of goods as a share of total output declined from 40% in the late 1940s, to about 33% in 1985.

From 1947 to 1985, service employment rose from 49% to 72% of total jobs. Measured service output is estimated to have increased from 60% to 67 percent. That suggests little change in the output of services per hour of labor input over the last four decades. But there are analysts who question whether productivity in the service sector is being adequately measured.

How did the output of goods rise continually over four decades, while the employment level remained steady? The answer lies in increased labor productivity. Employees gain experience, undergo training, are given better tools and a more efficient flow of work is put in place. With a more highly trained and experienced work force, new technology, and better manage-





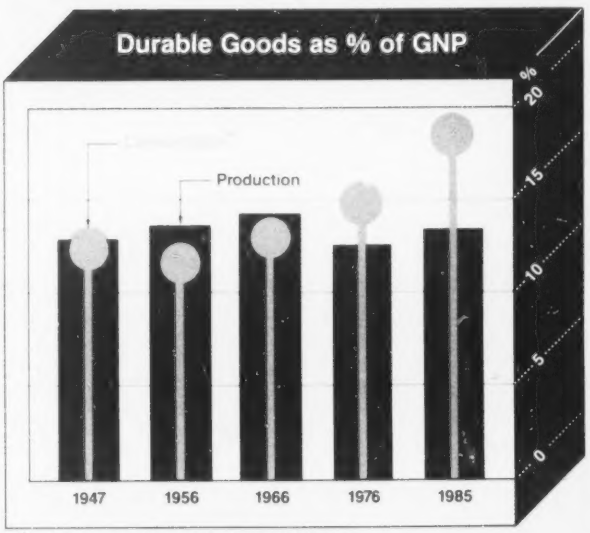


ment techniques, producers are able to turn out more and better goods, without having to increase the number of workers.

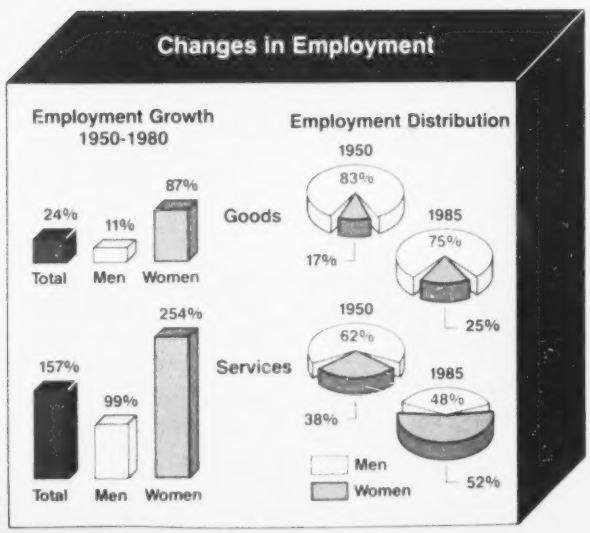
Higher productivity is associated with higher pay. During the postwar period, the added income was spent on the increased supply of available goods. Also, more people were employed in the distribution system, which was expanded to dispense those goods.

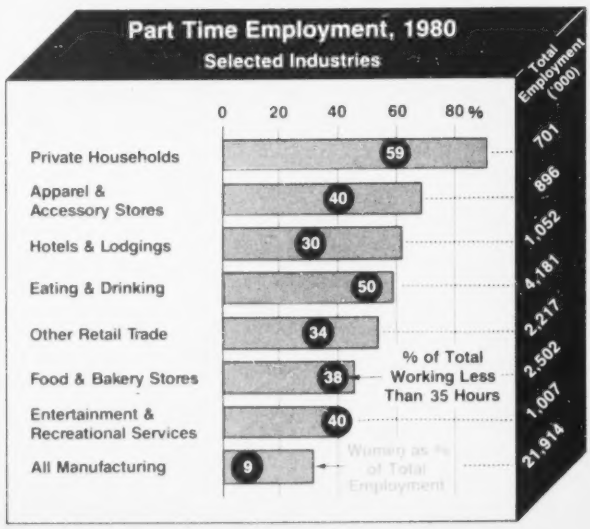
Given the meager net rise in goods-producing jobs, it was fortuitous that the growth in service employment remained very strong. The expansion of the service sector created employment opportunities for the baby-boom generation that began entering the labor force in the 1960s and 1970s. Job opportunities were also made available for the growing number of women entering the labor force.

More than half of all service jobs are held by women. One reason for this is that many of these jobs fit into time schedules that accommodate other aspects of their lives. Millions

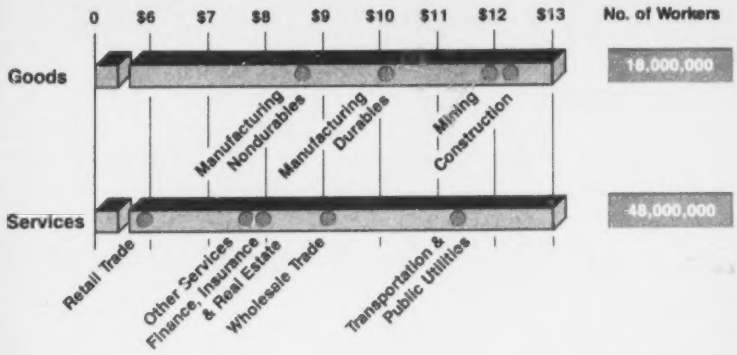


*Incl. Fixed Investment in Prod. Durables Equip.

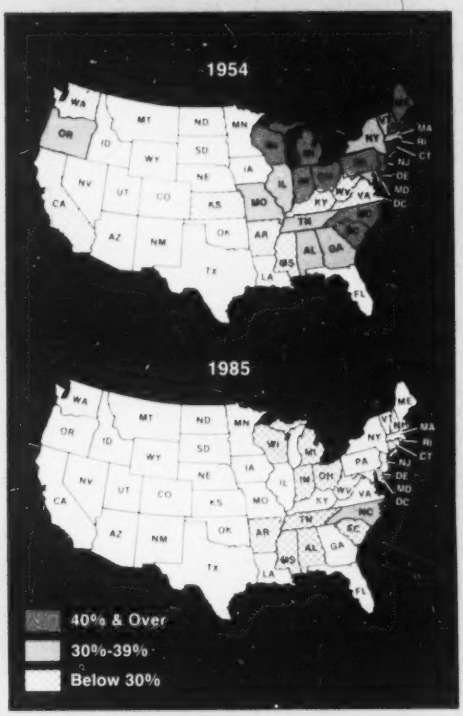




Average Hourly Wages of Production Workers by Sectors, 1985



States in which Manufacturing is the Largest Employer



Employment and Hourly Wages, 1985, Selected Industries

• Manufacturing

Industry	Average Hourly Earning ($)	Total Employment	% Change 1975-80	% Change 1980-85
Machinery, except Electrical	$10.29	1,311,000	+20	-18
Electrical & Electronic Equipment	9.47	1,305,000	+22	- 2
Transportation Equipment	12.72	1,251,000	+ 7	+ 1
Food & Kindred Prod.	8.57	1,122,000	+ 5	- 5
Apparel & Other Textile Prod.	5.73	948,000	+ 1	-12
Printing and Publishing	9.71	793,000	+12	+13
Rubber & Misc. Plastic Prod.	8.54	610,000	+20	+ 9
Chemicals & Allied Prod.	11.56	579,000	+ 8	- 8
Paper & Allied Prod.	10.82	516,000	+ 9	- 1
Leather & Leather Prod.	5.82	137,000	- 8	-30
Petroleum & Coal Prod.	14.06	107,000	+ 2	-14

• Services

Health Services	$ 8.05	5 617,000	+26	+20
Eating & Drinking Places	4.33	5,199,000	+35	+22
Business Services	8.18	3,859,000	+52	+43
Banking	6.84	1,256,000	+20	+ 4
Communications	11.74	1,006,000	+11	- 1
Amusement & Recrea. Svcs.	6.93	739,000	+27	+ 7
Legal Services	10.49	585,000	+40	+37
Motion Pictures	12.08	185,000	+ 6	- 3

of women work part time in apparel stores, hotels, eating and drinking establishments, etc. The limited work hours permit some women to devote time to education, to household tasks, and/or to attending to the care of children. However, polling routinely demonstrates that many part-time workers would prefer full-time jobs.

Eva Culen

SOURCES: U.S. Departments of Commerce and Labor; The Conference Board.

NOW AVAILABLE . . .

Economic Road Map charts in SLIDES

Each set of slides comes in a binder also containing 25 copies of the Road Map

The Conference Board, Inc.
845 Third Avenue
New York, NY 10022

☐ Please send me a set of slides for:
Economic Road Map Nos. 2011-2012
"Output & Employment: A 40-year Perspective"

Introductory Offer:
$110 ☐ $75 (Educational Institutions only)

☐ Enclosed is my check for $_____ ☐ Please bill me

Name _____ Title _____
Company _____ Tel. _____

Slides are also available for selected past issues.
For further information, please contact Eva Culen (212) 759-0900 ext. 328.

ECONOMIC ROAD MAPS

Eva Culen, Editor Chuck N. Tow, Chief Chartist
Prices for Quantities of this chart will be supplied on request to Information Service.

Published by
THE CONFERENCE BOARD, INC.
845 Third Avenue, New York, N.Y. 10022 Avenue Louise, 207 Bte 5 B-1050 Brussels, Belgium
THE CONFERENCE BOARD OF CANADA
255 Smyth Road, Ottawa, Ontario K1H 8M7, Canada

R4105-S.93 v.1(A)
7167

Economic Road Maps 1986 Index

ECONOMIC ROAD MAPS INDEX BY SUBJECT

Business Cycle
- Corporate Tax Liability 2005-06
- Dividends 2005-06

Corporate Profits
- Economic 2005-06
- Measures of 2005-06
- National Income 2001-02
- Quality 2005-06
- Wall Street Journal Survey 2005-06

Dividends
- Payment Rates 2005-06

Employment
- By Industry 2001-02
- By Sector 2001-02
- By Sex 2001-02

Federal Government
- Debt 2003-04
- Employment 2001-02
- Purchases 2001-02
- Research and Development 2007-08
- Wages and Salaries 2001-02

Foreign
- Doctoral Degrees 2007-08
- Profits 2005-06
- Research and Development Expenditures 2007-08
- Trade in Technology Intensive Products 2007-08
- University Level Students 2007-08

GNP
- Components 2001-02
- Per Capita 2001-02
- Research and Expenditure Ratio . . . 2007-08

Investment
- Gross Private 2001-02
- Nonresidential Fixed 2001-02, 2005-06
- Residential 2001-02

Labor Force
- Married Women 2001-02
- Scientists and Engineers 2007-08

Manufacturing
- After-Tax Returns 2005-06
- Wages and Salaries 2001-02

National Debt
- Distribution 2003-04
- Interest 2003-04
- Maturity 2003-04
- Ownership 2003-04

National Income
- Components 2001-02

Personal Income
- Distribution 2001-02
- Growth 2001-02

Population
- Population/Employment Ratio 2001-02
- By Sex 2001-02

Research and Development
Defense Related 2007-08
Foreign Expenditures 2007-08
Percent of GNP 2007-08
Source of Funds 2007-08
Type 2007-08

State and Local Government
Debt 2003-04
Purchases 2001-02

Stock Prices
S & P 500 2005-06

Taxes
Rates 2005-06

Unemployment
Rate 2001-02

U.S. Trade
Growth 2001-02
Manufactured Products Balance . . . 2007-08
Technology Intensive Products 2007-08

Wages and Salaries
By Sector 2001-02

NUMERICAL INDEX

2001-2002 A Half Century of Change: 50 Years of Economic Road Maps
2003-2004 National Debt
2005-2006 Corporate Profits: An Introduction
2007-2008 Research and Development

This series of charts is one of many prepared by The Conference Board. Further information about the Board and its research in business economics, business practices, public affairs and personnel administration is available on request from:

INFORMATION SERVICE

Prices for quantities of these charts will be supplied upon request.

ECONOMIC ROAD MAPS

Eva Culen, Editor Chuck N. Tow, Chief Chartist

1987 The Conference Board, Inc.
845 Third Avenue
New York, New York 10022

The Conference Board, Inc.
Avenue Louise, 207-Bte 5
B-1050 Brussels, Belgium

The Conference Board, Inc.
1755 Massachusetts Avenue, N.W.
Suite 312
Washington, D.C. 20036

The Conference Board of Canada
255 Smyth Road, Suite 100
Ottawa, Ontario, K1H-8M7